EECS 373 - Homework #6

Name: _____ unique name: _____

For this assignment, make a copy of this Google Doc and use the answer boxes provided to fill in the answers to the questions. The source file for this document can be found on the class website. Students are encouraged to type out their answers, but neatly handwritten answers will also be accepted where appropriate. Gradescope is set up to accept variable length assignments. Once students upload a PDF of their completed assignment to Gradescope they will need to designate where they responded to each question.

Question 1: Short Answer [20 points, 4 each]

Briefly answer the following questions about different communication interfaces:

1.1) Why do we use serial interfaces when communicating with peripheral devices, when parallel buses with multiple data lines can be simpler and faster?

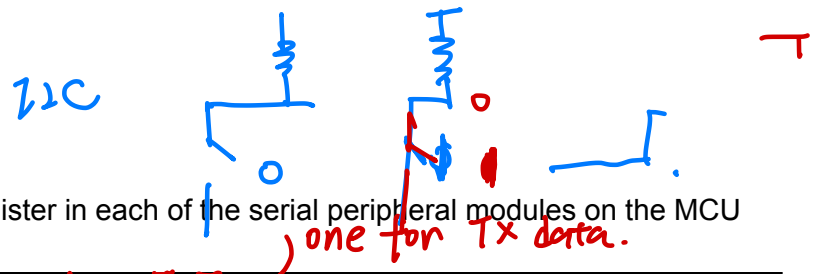
cost.
less wire.
not high speed communication.
longer distance

1.2) What are the disadvantages of UART relative to the other serial interfaces (I2C, SPI)?

low speed. UART
Asycronize.
Only one to one.
5.6.7.8 bit
parity
start bit.
P
end
SPI. CS
clk

1.3) Why would we want to use I2C over SPI for a peripheral that can communicate using both?

only 2 line
failure.
can do multiple controller.
SDO
SDI.
data packet.
4.8.
clk
I2C
7bit address W/R ACK
8bit data
Address
start
end.

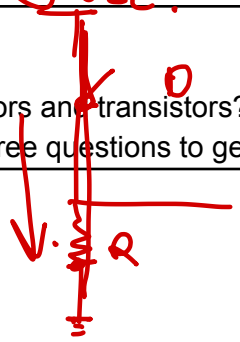


1.4) What is the role of the FIFO register in each of the serial peripheral modules on the MCU and why are they important?

serial ports have 2 independent FIFO. one for Tx data. one for Rx data.
Tx FIFO register allows the system to place a number of bytes into the queue and serial hardware will take care of the orderly transmission.
Rx FIFO register. temporarily store the incoming data until the system gets a chance to process it.

1.5) Would it be possible to redesign I2C to use pull down resistors and transistors? How would this work? Name one advantage or disadvantage? Answer all three questions to get full credit.

Yes.
change to PMOS. + pull down resistor.



Question 2: Serial Tradeoffs [16 points]

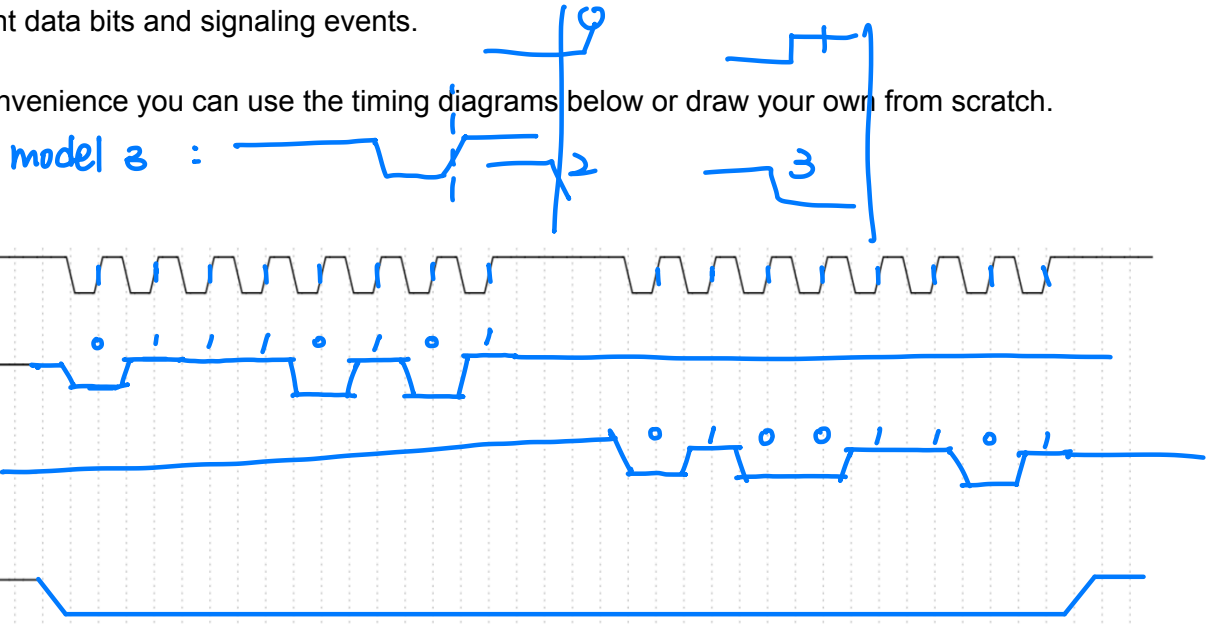
Put an "X" in the appropriate box if the statement is true. Otherwise leave the box blank. A given statement can be true for all, some, or none of the given interfaces.

Statement	UART	I2C	SPI
Has a clock signal for synchronization	X	✓	✓
Selects target device with a select wire	X ?	X	✓
Allows multiple devices to initiate transaction	X ✓	✓	✓ X
Capable of sending data in two directions at once	✓ X	X	✓
Sends an address as part of its protocol	X	✓	X

Question 3: SPI Waveform [19 points]

Using an MCU you are asked to communicate with an external SPI module. When the SPI controller sends the SPI peripheral a 'U' in ASCII the device responds with an ASCII 'M'. Assume all data is sent and received in MSB first format and the SPI modules are in SPI Mode 3. Your task is to draw a timing diagram of this transaction. Make sure to clearly label the relevant data bits and signaling events.

For convenience you can use the timing diagrams below or draw your own from scratch.



MSB ↓ LSB

U: 0 1 1 1 0 1 0 1

M: 0 1 0 0 1 1 0 1

Question 4: I2C Waveform [25 points]

96 + 7 = 103.

You are given a temperature sensor that communicates via I2C. You write the ASCII character 'F' to the address 0x41. You then read from that address and receive the temperature in degrees Fahrenheit. The temperature sensor returns the decimal value '103'. Draw the waveform for the transaction. Make sure to clearly label the relevant data bits and signaling events.

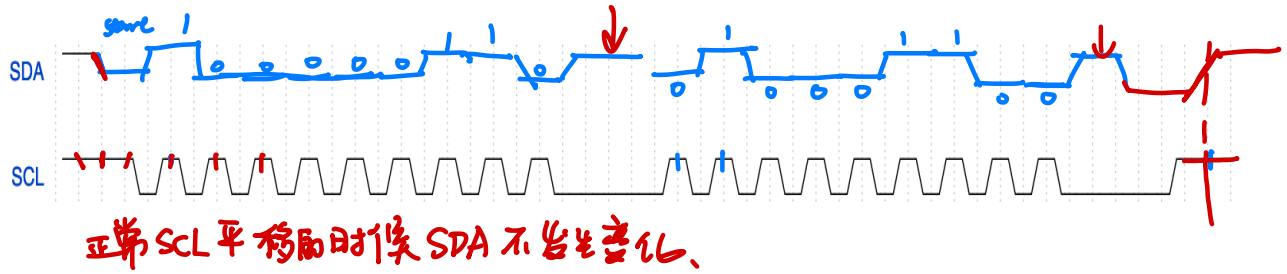
0x41 0 1 0 0 0 1 0 0 0 1 1 0 1 1 0 0 1 1 1

For convenience you can use the two blank timing diagrams below or draw your own from scratch.

先往 0x41 write "F"

再从 0x41 Read "103"

"F": 0100 0110.



正常 SCL 平稳的时候 SDA 不会发生变化。